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Purpose of Investigation

The study was instigated for the purpose of determining the extent, availability, type and physical characteristics of granites in the Rocklin area which would be satisfactory for use in the granite industry and to establish some basis for a valuation of property needed as right-of-way for proposed freeway construction in the area.

The work was authorized under W.O. 3QT444, III-Pla-17-A, Roc. B, Project No. 70.

General Description of Granite

Granitoid rock like that composing the Sierran batholith includes true granite and other rocks closely associated in chemical and mineral composition. The rocks have probably been formed at depths of at least a mile below the surface. For this reason the growth of crystal grains has been relatively slow and the rocks are generally medium to coarse grained. There are areas which contain very coarse grained or pegmatic types in the Sierras. The Sierra granites are usually light colored, predominantly gray, with isolated masses of darker granites. Granite consists essentially of two main minerals, feldspar and quartz, the feldspar predominating. The accessory minerals are hornblende, mica, magnetite and sometimes other minor constituents. The combination of light and dark minerals account for the so-called salt and pepper appearance.

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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

GEOLOGICAL INVESTIGATION

of the

ROCKLIN GRANITE

III-Pla-17-A,Roc,B

May 1958

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May 26, 1958

III-P1a-17-A,Roc,B
Lab Auth. 2242-20-T

Mr. Alan S. Hart
District Engineer
Division of Highways
Marysville, California

S + H-Constr.
Tax-Land Value
Econ-T.P.B.

Dear Sir:

Submitted for your consideration is:

REPORT

of

GEOLOGICAL INVESTIGATION

of the

ROCKLIN GRANITE

Study made by.....Foundation Section
Under general direction of.....A. W. Root
Work supervised by.....E. D. Drew
Report prepared by.....E. D. Drew

Very truly yours,

F. N. Hveem
Materials & Research Engr.

cc:JWTrask
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Dist. Design Dept.-2

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Definition Rock and Stone

Rock and stone are often regarded as being synonymous. There is a distinction which should be understood when referring to rock that is to be used for commercial purposes. Bowles* states "The term 'rock' is applied to a geologic formation in its crude form as it exists in the earth. 'Stone' is more properly applied to individual blocks, masses or fragments that have been broken from the original massive ledges for use in commercial application.

"'Dimension stone' is a term generally applied to masses of stone prepared for use in the form of blocks of specified shapes and usually specified sizes."

For clarification and simplification the rock term granite will be used in referring to rock or stone in the Rocklin area.

Hardness - All fresh, unweathered granites are usually very hard due to the principal component minerals having a hardness of 6 and 7 which is as hard as some types of steel.

*Bowles, Oliver, 1939, The Stone Industries, McGraw-Hill, New York

Texture - The texture of granite signifies the size and arrangement of mineral grains. Granites are classed as fine to medium to coarse grained rocks. Medium grained granites are those in which the feldspars average about one-fourth inch across. Even distribution of the light and dark minerals in the rock give a uniform color and texture.

The granites of the Rocklin area are fine to medium grained and have a uniform color and texture.

Color - Feldspar being the most abundant mineral in granite usually determines the color which is light gray. Variations are caused by other minerals such as hornblende, mica and the pink and red feldspars. The Rocklin granite varies from a light to medium dark gray.

Strength - Nineteen samples of Rocklin granite were tested and showed an average compressive strength of 16,846 psi.

Durability - The durability of granite is generally good, based on examination of stone in buildings and other installations. It is difficult to assess the durability of stone using test methods now available, such as freeze-thaw, sodium sulphate, Los Angeles Rattler and the Wet Shot. It is known that the Rocklin granites have exceptional field service records, whereas the test results are sometimes below the normal.

Rocklin Area

History - Background

Granite has been produced in the Rocklin area since 1863. During one period over 20 quarries were in operation; at present only one is active, the Union Granite Company owned by the Ruhkala Bros. In the 30 years the company has been operating, they have produced from one pit approximately 420,000 cu.yds. of granite. The granite was used for various purposes, monuments, building stone, riprap, curbing, culverts and abutments. At present the stone produced in the Rocklin area is used principally for monuments. The monuments are usually the small headstone type there being little demand for the large ornamental and sculptured type produced in past years. Waste rock is crushed for poultry grit, driveways, fills, etc., rock for riprap can be produced on order. Some black granite from the Penryn area is used for monumental purposes, but constitutes a very small portion of the Rocklin output.

Value and Production

The latest figures available show the total value of dimension stone produced in California for the year 1955 was about $700,000. The value of granite dimension stone produced in California for 1955 was worth $250,000. There is no way of determining the exact value of stone produced during the year from the Rocklin quarry but a broad estimate would be $25,000.

The last large order (1920) was for a building in San Francisco, when granite valued at $213,000 was produced.

Geology Rocklin Area and Potential

The Rocklin granite is an outlier or apophysis of the main Sierra Nevada batholith and is a more resistant area on the west edge of a granite mass about 5 miles wide and 20 miles long. The Rocklin area proper comprises approximately 350 acres. A portion of this acreage is covered by homes, townsite, railroad and small industrial development. The area is delimited on the west by recent sediments of the valley, so that roughly about ½ the acreage would not be available for quarrying operations. The granite in the surrounding area is deeply weathered and is usually confined to small isolated outcrops which have no economic potential.

Types of Quarries and Operations

In the Rocklin area two types of quarries have been operated, "the shelf" and "pit." The shelf quarry is operated from a floor level and worked into the hillside. This is a low cost operation and has many advantages such as transportation, drainage and ready access. At least three of the older quarries along Secret Ravine Creek were operated as shelf quarries and later as pit quarries.

In the pit operation conditions are not so favorable; the rock does not extend above the surface and an excavation must be made. Access is by hoists, ladders, inclined tracks or elevators. It is often necessary to install pumps, as the quarry extends down below ground water level. Efficient and economical operation of a pit type quarry depends on a large extent to the utilization of modern equipment and methods. The present operating quarry in Rocklin is of the pit type and is now over 100 ft. in depth.

It is possible considerable tonnage could be produced by the shelf method on that portion of Parcel 10054 and 10051 adjacent to Secret Ravine Creek. Adverse factors would be transportation and access.

Prices and Value

Granite can be imported as cheaply as stone quarried in the United States, especially where it is utilized as ship ballast. The 1955 value of rough granite monumental grade is $4.25 cu. ft. at the quarry, dressed granite monumental grade is $8.50 cu. ft. at the quarry. Imported block sells for from $5 to $20 per cubic foot f.o.b. San Francisco. Rough stone is sold at the quarry to wholesale stone dealers, or to stone yards and contractors at prices ranging from $22 to $28 per ton.

The prevailing wage scale for a stone worker in 1956 was $23.80 per diem. According to (Goldman 1957 pp 605, 606) "The monumental stone market is virtually limited to stone from specific localities, that have become widely known and used. Therefore it is difficult if not impossible to open a monumental stone quarry and put a new stone on the market.

"A moderate scale operation probably would require an initial expenditure of approximately $100,000.

"The outlook for the expansion of the dimension stone industries is fair. The market for monumental stone has been growing and the merits of using natural building stone are being increasingly recognized by architects, builders and the general public. The new use for granite as surface plates will help production a little."

It cannot be anticipated that an increase in the granite industry will occur. The trend from 1932 to 1952 has been fairly constant, there has been a definite increase from 1952 to 1955. The use of dimension stone for homes, small industrial buildings and construction purposes has induced this trend.

Laboratory Tests

Six types of laboratory tests were made on seven samples of granite from the Rocklin Area. Three of the samples were dimension stone from one active quarry and four samples from waste piles of abandoned quarries. The results of the tests are shown in Table I.

Comparison of Test Results

From the results shown in Table I it can be seen that except for one sample (58-740) the granite from the existing quarry and from the areas adjacent to the proposed roadway are similar. Although the sample from a waste pile to the right of Sta. 210 fails to meet the test requirements atmospheric weathering has probably caused a breakdown of mineral constituents which could not be detected in the field.

The granite from parcel #10054 appears to be equal to granite now being produced from the active quarry.

The Division of Highways does not include in the specifications a test for dimension stone as used for building or dimension stone. Therefore, the tests for the evaluation of the Rocklin granite are principally those used for construction purposes, although the tests for specific gravity, absorption and strength are often used to evaluate dimension stone.

Goldman, H. B., 1957, Mineral Commodities of California, California Division of Mines, Bull. 176.

Tests

Specific Gravity

The specific gravity of each of the granite samples was determined. It ranged from 2.56 to 2.63. The specific gravity of the granites are above the minimum of 2.5 as set forth in the Standard Specifications.

Absorption

The absorption ranged from 0.4 to 1.2.

Los Angeles Rattler

The rattler losses are considerably higher on the average than is normally expected from granites of the Rocklin type. When the rock is to be used for riprap Standard Specifications specify 40% as the minimum loss for 500 revolutions. The loss on the Rocklin granite ranged from 36.0 to 78.8. This is incongruous with the known fact that the field service record of Rocklin granite has been excellent. This test should not be considered as a criterion for the evaluation of the granite as dimension stone or when used for other purposes.

Abrasion, Deval Machine (Wet Shot Rattler)

Except for one sample the Rocklin granite is well within specification limits, with a range from 14.1 to 45.6. The one (45.6% loss) sample was from a waste pile that had been subjected to atmospheric conditions for an unknown period of years.

Compressive Strength

The strength of rocks is not a reliable criterion of the potential durability. The compressive strength of granite is variously reported in the engineering hand books from 20,000 to 51,900 lbs./sq. in. It is commonly rated between 12,000 and 16,000 lbs./sq. in. The results obtained are highly variable and do not justify the time and expense involved in performing the test. The Rocklin granites ranged from 10,000 lbs./sq. in. to 20,000 lbs./sq. in. The compressive tests were made for the purpose of comparing the strength requirements for commercial dimension stone (5000 pounds per square inch) with the Rocklin granite.

Conclusions

From the results obtained from the physical tests it can be assumed that the Rocklin granites are satisfactory for use as dimension stone, and this is more conclusive in regard to the field observations of monuments, structures, and riprap installations.

Potential as Dimension Stone

Assuming that parcel No. 10054 contains 6.2 acres or 27,000,000 cu. ft., at 165# per cu. ft. this would give a tonnage of approximately 2,222,000 tons of granite available in the parcel. Based on current prices of dimension stone at $25 per ton, the value would be $56,000,000. The figures exceed the tonnage and value of granite produced in the entire State for the period 1887 to 1955. The total value of granite produced in Placer County which includes the Rocklin area in the period 1863 to 1955 is over 3 million dollars.

The above figures do not include wastage, and cost of setting up a quarry operation, but assumes that 100% dimension stone could be produced which of course is very improbable.

The Union Granite Co. has been operating from a quarry of approximately two acres in extent for a period of 30 years.

There are 438 acres in the Rocklin area, which are considered to be underlain by granite suitable for quarry operations. Areas to be excluded consist of 171 acres, (Area A on map) which include the town of Rocklin; residential sites, cemeteries, and small farms. This would leave a potential area of 267 acres (Area B on map) from which it would be possible to produce granite. On the attached print are outlined the active and inactive quarries and the exterior boundary of the Rocklin granite.

Electrical resistivity measurements made within the proposed right-of-way between Sta. 201+00 to Sta. 213+00 show the average depth of soil, gravel and weathered granite to be approximately 10 feet. It would be necessary to strip the area below this depth before quarrying operations could begin.

It would be possible to produce an unlimited supply of granite satisfactory for all purposes from property within the 267 acres.

It would be possible to produce from the acreage remaining in parcel #10054 exclusive of the 6.2 acres required for right-of-way sufficient granite of dimension stone quality to meet all potential requirements for many years to come.

Recent purchases of property in the Rocklin area for the purpose of quarrying stone indicated a price of $410 per acre.

TABLE I

ROCKLIN GRANITE INVESTIGATION
RESULTS OF LABORATORY TESTS

Sample Designation	Sp.Gr.	% Abs.	L.A.R.T. % Loss 100R	L.A.R.T. % Loss 500R	Wet Shot Rattler % Loss	Compressive Strength Lbs/sq.in.
51-1638 Fine-grained gray*	2.63	0.4	6.4	36.0	14.1	11,300
51-1639 Coarse " " *	2.62	0.5	11.2	42.6	21.2	20,100
58-725 Fine " " *	2.58	1.2	11.8	48.0	26.7	14,000
58-726 " " " °	2.61	0.7	10.8	43.6	16.9	17,000
58-727 " " " °	2.61	0.6	10.6	42.0	18.2	-
58-740 " " Rt. of Sta. 210°	2.57	1.1	26.4	78.8	45.6	10,000
58-740 Check sample	2.57	1.1	31.0	80.0	47.6	-
58-871 Fine grained gray Lt. of Sta. 207°	2.63	0.4	10.4	42.8	18.7	-

*Dimension or monumental stone - active quarry
°Waste rock from abandoned quarries